

Preface

To the Instructor

The laboratory exercises in this manual are coordinated with *Biology*, a general biology text that covers the entire field of biology from an evolutionary perspective.

Although each laboratory is referenced to the appropriate chapter(s) in *Biology*, this manual may also be used in coordination with other general biology texts. In addition, this laboratory manual can be adapted to a variety of course orientations and designs. There are a sufficient number of laboratories and exercises within each lab to tailor the laboratory experience as desired. Then, too, many exercises may be performed as demonstrations rather than as student activities, thereby shortening the time required to cover a particular concept.

The Exercises

All exercises have been tested for student interest, preparation time, time of completion, and feasibility. The following features are particularly appreciated by adopters:

Integrated opening: Each laboratory begins with a list of Learning Outcomes organized according to the major sections of the laboratory. The major sections of the laboratory are numbered on the opening page and in the laboratory text material. This organization will help students better understand the goals of each laboratory session.

Self-contained content: Each laboratory contains all the background information necessary to understand the concepts being studied and to answer the questions asked. This feature will reduce student frustration and increase learning.

Scientific process: All laboratories stress the scientific process, and many opportunities are given for students to gain an appreciation of the scientific method. The first laboratory of this edition explicitly explains the steps of the scientific method and gives students an opportunity to use them. I particularly recommend this laboratory because it utilizes the pillbug, a living subject.

Student activities: A color bar is used to designate each student activity. Some student exercises are Observations and some are Experimental Procedures. An icon appears whenever a procedure requires a period of time before results can be viewed. Sequentially numbered steps guide students as they perform each activity.

Live materials: Although students work with living material during some part of almost all laboratories, the exercises are designed to be completed within one laboratory session. This facilitates the use of the manual in multiple-section courses.

Laboratory safety: Laboratory safety is of prime importance, and the listing on page viii will assist instructors in making the laboratory experience a safe one.

Improvements in This Edition

All laboratories have been revised to:

1. Increase student participation by improving the learning outcomes and by applying the scientific method to many laboratory procedures. Students are invited to hypothesize the outcome of procedures; an improved wrap-up is provided so that students can come to a conclusion based on the results.

2. Increase relevancy by including applications of interest to students. For example, in Laboratory 4 students test various over-the-counter antacids for their ability to buffer HCl, and in Laboratory 5 the poisonous nature of hydrogen peroxide and the need for catalase activity in cells is exemplified by picturing a product utilizing hydrogen peroxide as an everyday antiseptic.

I am pleased to report that the following laboratories have been extensively revised:

Laboratory 3: Chemical Composition of Cells

Increased student involvement allows students to independently carry out testing the chemical composition of everyday materials and an unknown.

Laboratory 6: Photosynthesis

Utilization of the scientific method results in student appreciation of pigment utilization by plants to increase primary productivity. A new interactive section allows students to summarize the process of photosynthesis in a chloroplast.

Laboratory 7: Cellular Respiration

Utilization of the scientific method and appropriate illustrations increases relevancy and student participation in a laboratory that contrasts fermentation with cellular respiration.

Laboratory 10: Human Genetics

This population lab has been enhanced by a reorganization that allowed additional genetics problems, including an interactive exercise that helps students construct a pedigree.

Laboratory 12: Evidences of Evolution

A new section on the geologic timescale precedes an examination of fossils that focuses on student observational skills. The comparison of chimpanzee and human skeletons was rewritten to include additional questions, conclusions, and art. A new interactive summary asks students to come to conclusions about the evidences of evolution.

Laboratory 16: Nonvascular Plants and Seedless Vascular Plants

This lab now reflects the latest understanding of plant evolution and includes an observation of *Chara* as the living alga most closely related to land plants and lycophytes as representative of the first plants to have vascular tissue.

Laboratory 21: Reproduction in Flowering Plants

A new interactive examination of the flowering plant life cycle leads to an appreciation of the role of pollinators and coevolution in the success of flowering plants. Observation of fruits has been simplified in order to give students an opportunity to better appreciate the role of fruits in the plant life cycle.

Laboratory 22: Introduction to Invertebrates

Walks students through the modern phylogenetic tree of animal evolution based on molecular data. The lab also now gives students the opportunity to make their own observations of the noncoelomate invertebrates, such as living hydra and planarian, and report their findings.

Laboratory 29: Homeostasis

Reorganization has sharpened the focus of this lab on homeostasis, including the contribution of certain organs such as the liver and kidneys whose activities are under hormonal control.

Laboratory 34: Sampling Ecosystems

This lab was rewritten to make a field experience more enjoyable and practical for both the instructor and students.

Customized Editions

The 35 laboratories in this manual are now available as individual “lab separates,” so instructors can custom-tailor the manual to their particular course needs.

Laboratory Resource Guide

The *Laboratory Resource Guide*, an essential aid for instructors and laboratory assistants, free to adopters of the *Laboratory Manual*, is online at www.mhhe.com/maderbiology10. The answers to the Laboratory Review questions are in the *Resource Guide*.

To the Student

Special care has been taken in preparing the *Biology Laboratory Manual* to enable you to **enjoy** the laboratory experience as you **learn** from it. The instructions and discussions are written clearly so that you can understand the material while working through it. Student aids are designed to help you focus on important aspects of each exercise.

Student Learning Aids

Student learning aids are carefully integrated throughout this manual. The Learning Outcomes set the goals of each laboratory session and help you review the material for a laboratory practical or any other kind of exam. The major sections of each laboratory are numbered, and the Learning Outcomes are grouped according to these topics. This system allows you to study the chapter in terms of the outcomes presented.

The Introduction reviews much of the necessary background information required for comprehending upcoming experiments. Color bars bring attention to exercises that require your active participation by highlighting Observations and Experimental Procedures, and an icon indicates a timed experiment. Throughout, space is provided for recording answers to questions and the results of investigations and experiments. Each laboratory ends with a set of review questions covering the day's work.

Appendices at the end of the book provide useful information on preparing a laboratory report, the metric system, and the Tree of Life. Practical examination answer sheets are also provided on the website.

Laboratory Preparation

Read each exercise before coming to the laboratory. **Study** the introductory material and the procedures. If necessary, to obtain a better understanding, read the corresponding chapter in your text. If your text is *Biology*, by Sylvia S. Mader, see the "text chapter reference" column in the table of contents at the beginning of the *Laboratory Manual*.

Explanations and Conclusions

Throughout a laboratory, you are often asked to formulate explanations or conclusions. To do so, you will need to synthesize information from a variety of sources, including the following:

1. Your experimental results and/or the results of other groups in the class. If your data are different from those of other groups in your class, do not erase your answer; add the other answers in parentheses.
2. Your knowledge of underlying principles. Obtain this information from the laboratory Introduction or the appropriate section of the laboratory and from the corresponding chapter of your text.
3. Your understanding of how the experiment was conducted and/or the materials used. *Note:* Ingredients can be contaminated or procedures incorrectly followed, resulting in reactions that seem inappropriate. If this occurs, consult with other students and your instructor to see if you should repeat the experiment.

In the end, be sure you are truly writing an explanation or conclusion and not just restating the observations made.

Color Bar and Icon

Throughout each laboratory, a color bar designates either an Observation or an Experimental Procedure.

Observation: An activity in which models, slides, and preserved or live organisms are observed to achieve a learning outcome.

Experimental Procedure: An activity in which a series of steps uses laboratory equipment to gather data and come to a conclusion.



Time: An icon is used to designate when time is needed for an Experimental Procedure. Allow the designated amount of time for this activity. Start these activities at the beginning of the laboratory, proceed to other activities, and return to these when the designated time is up.

Laboratory Review

Each laboratory ends with a number of thought questions that will help you determine whether you have accomplished the outcomes for the laboratory.

Student Feedback

If you have any suggestions for how this laboratory manual could be improved, you can send your comments to:

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